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National Agricultural Pesticide Impact Assessment Program

Proceedings of a Workshop:

Developing Benefits Assessment Protocols

October 21-23, 1997

Raleigh, North Carolina

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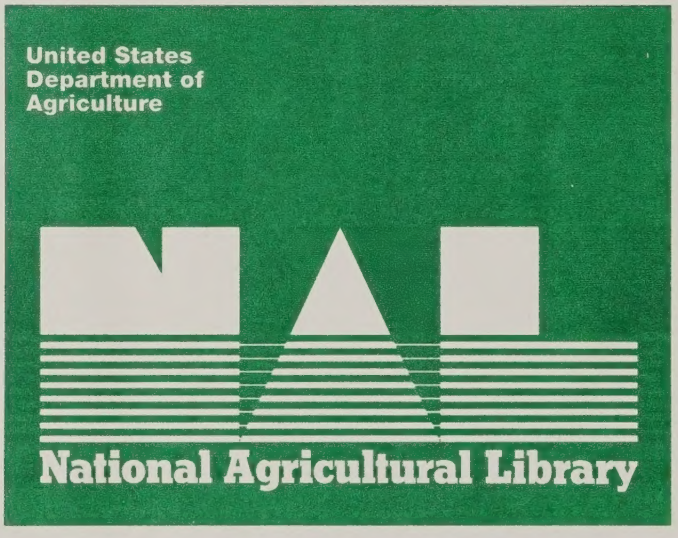
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Proceedings of the Workshop on Benefits Assessment Protocols
October 21-23, 1997 Raleigh, N.C.

Edited By Ronald E. Stinner

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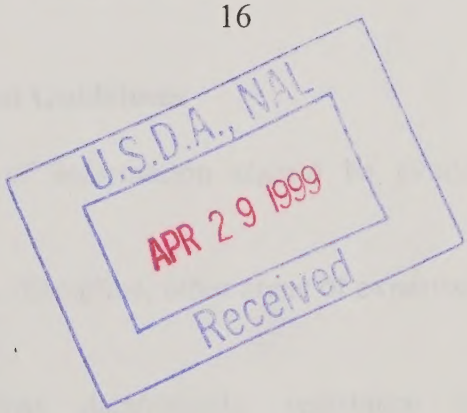

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This publication is also available on the internet at http://ipmwww.ncsu.edu/usdanapiap/protocols/

Proceedings of the Workshop on Benefits Assessment Protocols

October 21-23, 1997 Raleigh, N.C.

Executive Summary

A workshop held in Raleigh, North Carolina, on October 21-23, 1997, was conducted to provide guidelines for the development of protocols for pesticide benefits assessments for regulatory purposes. The participants included university scientists and extension specialists, together with individuals providing perspectives from commodity organizations, government (USDA and EPA), agribusiness, and grower concerns. A full list of participants, workshop agenda, and discussion topics is available in the full report available through USDA/ARS/NAPIAP or the NSF Center for Integrated Pest Management.

The following represents a brief overview of the recommendations of the Workshop. Participants were in general agreement and all have had the opportunity to review this document.

Primary Recommendation

The workshop participants recommend the establishment of an *ad hoc* group responsible to USDA/NAPIAP and EPA. This group should have representatives from all the major stakeholder organizations. The charge to this *ad hoc* group would be to prepare recommendations for specific protocols, designed to estimate pest damage (crop loss), based on the guidelines developed during this workshop.

Specific protocols should address (1) database and information types and sources, (2) data quality assurance measurements, (3) data analysis procedures and output structure, and (4) report and analysis review and response. These protocols should provide a standardization of requirements for benefits assessments based on scientific evidence and commonly accepted methods of data analysis and interpretation. The rationale for the development of these protocols is presented in brief below and in more detail in the full proceedings.

Protocol Development Guidelines

Information/Databases – Types. The following types of information should be available for benefits assessments and be included as part of the protocols.

Inventory of relevant scientists (by state, commodity, discipline, other areas of expertise). This inventory should be publicly accessible.

Pest Database. This should include crop loss data/models, resistance information, and geographic/seasonal incidence.

Pesticide Database. This should include a list of approved or preferred information sources including specific journals and databases(by crop), pesticide alternatives, efficacy, and economic information (market share, usage, price).

Crop Statistics. This should include, at the least, acres planted, distribution, price, and quality measurements (e.g., oil content, fresh market versus canning quality, where appropriate).

Data from each of the latter three types (pest, pesticide, crop) are required to estimate crop loss and potential net economic benefits from specific pesticide use.

Information/Databases – Sources. Regardless of the source, it should be a requirement that the information be identified as to source documentation, authors, methodologies used, and quality (see next section for more on quality). Priority should be given to information from published (peer-reviewed) databases/documents, followed by surveys/questionnaires, unpublished hard (experimental) data, and, lastly, scientific estimates. *Protocols based on this approach can be scientifically justified, while still allowing flexibility where experimental data are lacking, contain divergent results, or are of disputed value.*

Quality Assurance. Specific quality standards criteria must be developed for varying types of data. The criteria may be different for experimental data as opposed to surveys, questionnaires or scientific estimates. As an example, for experimental data, the workshop participants recommended the use of a quality index (Borth Index, see page 7 of full proceedings) which considers *in situ* replication, together with replication across regions and growing seasons. Data and databases which have higher levels of replication can be weighted more heavily in the decision process than similar information with less replication through time or geographically. *Developing protocols for information quality, as outlined above, are a necessity for accurate and reproducible benefits assessments.*

Analysis/Output Structure. Most importantly, criteria for protocols in this area must address documentation of any analysis or modeling. Any output which alters the data or databases used must be documented and the results reproducible (i.e., results can be recreated). Protocols in this focus area must also define output shell(s) or template(s) for defined user groups (e.g., EPA decision-makers or commodity group analysts). For regulatory purposes, the analysis/model output should be in a form with direct utility to the regulatory decision process, with no or minimum alteration required. *This will reduce response time and potential misinterpretations of analysis/model results.*

Peer Review. These protocols must be established to determine who reviews assessments and how they are reviewed. Such protocols will also protect all affected parties. All stakeholders should be represented in the review process (registrants, state agricultural extension services, commodity groups, regulatory agencies, and environmental/safety concerns). These protocols must consider appropriate experts from the categories above, actual time constraints, conflict resolution, and feedback to/from the reviewers. *Because all data and analyses are in part subjective, peer review should be a prerequisite to any benefits assessment and review protocols developed.*

Attendees*

Invited Participants

Michael Aerts, University of Florida (Agronomy)
John Ayers, Pennsylvania State University (Plant Pathology)
Ron Davis, ARS (Plant Pathology)
Leonard Gianessi, National Center for Food and Agricultural Policy (Economics and Policy)
Paul Gillebeau, University of Georgia (Entomology)
Linda Herbst, University of California, Davis (Agronomy)
Lynnae Jess, Michigan State University (Agronomy)
Norman Nesheim, University of Florida (Plant Pathology)
Robert Nichols, Cotton Incorporated (Research Policy)
David Pike, University of Illinois (Agronomy)
Larry Olsen, Michigan State University (Entomology)
Donald Rutz, Cornell University (Entomology)
Ken Sorensen, North Carolina State University (Entomology)
Steve Toth, North Carolina State University (Entomology)
Maury Weise, University of Idaho (Plant Pathology)

Moderator/Facilitator

Ron Stinner, NSF Center for IPM, North Carolina State University

Speakers

Leonard Gianessi, National Center for Food and Agricultural Policy (Economics and Policy)
Charles Main, North Carolina State University (Plant Pathology)
Robert Nichols, Cotton Incorporated (Research Policy)
David Pike, University of Illinois (Agronomy)
Ronald Stinner, North Carolina State University (Entomology)
Gail Wilkerson, North Carolina State University (Agronomy)

Stakeholder Representatives**

EPA – David Brassard
USDA/ARS/NAPIAP – Nancy Ragsdale
USDA/CSREES/NAPIAP – Dennis Kopp
Industry – Paul Borth, Dow AgroSciences
Commodities – Robert Nichols, Cotton Incorporated
Non-Profit Research – Leonard Gianessi, National Center for Food and Agricultural Policy

* Individual attendees may be listed in more than one group.
** Stakeholder representatives served as information sources and provided sector perspectives.

Agenda for
Benefits Assessment Protocols Workshop

October 21-23,1997
Raleigh, North Carolina

Tuesday, October 21

1:00 - 2:30 pm Welcome - Ron Stinner, CIPM
Introduction/Background Review - Nancy Ragsdale, NAPIAP
FQPA Impact/Risk vs. Benefits - Dave Brassard, EPA
Charge to Work Groups - Nancy Ragsdale - NAPIAP

2:30 - 3:00 pm BREAK

3:00 - 5:00 pm Three work groups will meet: each group focusing on a different pest category (insect, disease, weed). Their charge will be to establish parameters for yield variability, the rationale for geographic specificity. The groups will discuss what protocols can be quickly and uniformly established. How can benefits (such as yield primarily) impacts be compartmentalized and identified to make the process transparent, that is, with justification and accountability.

Wednesday, October 22

8:00 - 9:45 am Work group reports and group discussion - what protocols are reasonable to establish for regulatory purposes? Have any major considerations been ignored?

9:45 - 10:00 am BREAK

10:00 - Noon What's available? Explanations and "hands-on" demonstrations of several databases and approaches - Charles Main, Gail Wilkerson, Leonard Gianessi, Robert Nichols, David Pike, Ron Stinner

12:00 - 1:00 pm LUNCH

1:00 - 4:00 pm Work groups separate again to do a "benefits analysis" walk-through. The insect group will have a specific problem on crucifers, the disease/nematode group will have grapes, and the weed group will have soybean.

The selection of crops is based on wanting to provide a breadth of problems. Crucifers represent a "limited-use" crop with major resistance problems. Grapes are a perennial crop with a wide distribution and both "table" juice and wine markets. Soybean, with new genetically engineered varieties, provide a major field crop.

As the work groups develop their benefit analysis, they will be asked to emphasize the needs and protocols which should be of a general nature and any which might be pest or crop-type specific.

4:00 - 5:00 pm Each work group will develop a report on how they achieved their benefits analysis. What information was critical, what data useful, what information was needed but not available, and what protocols could be established to ensure a scientifically justified (transparent) assessment. Each group will be asked to prioritize their suggested protocols, reflecting how meaningful and achievable the resulting data should be for regulating purposes. A written report will be due the following morning.

Thursday, October 23

8:00 - 9:30 am Each group will have a half-hour report time.

9:30 - 10:00 am BREAK

10:00 - Noon The entire group will identify "necessary" protocol areas and group-specific protocols. The entire group will be expected to develop a prioritized list of general protocols and recommendations for further consideration by NAPIAP, EPA, and stakeholder groups.

During the Workshop, a recorder will be provided to keep an accurate record of discussions. The group reports and abstracted discussions will be compiled into a Proceedings, to be made available in electronic and printed form to NAPIAP prior to December 31, 1997.

Discussion I Synopsis

Workshop participants were separated into three discussion groups with general responsibility for weeds, insects, and plant pathogens. Participants were placed into groups according to expertise. The three groups were:

Weeds	Insects	Plant Pathogens
Giannessi	Borth	Aerts
Pike, Chairman	Toth	Ayers, Chairman
Herbst, Recorder	Gillebeau, Chairman	Weise
Nichols	Rutz, Recorder	Neisheim, Recorder
Kopp	Sorensen	Olsen
Jess		Davis

Drs. Nancy Ragsdale (USDA/ARS/NAPIAP), David Brassard (EPA), and Ronald Stinner (NSF Center for Integrated Pest Management) served as resource personnel and rotated among the three groups. It is important to note that 'benefits' assessment is only part of the review process, which includes both risk and benefits review.

Historically, the term 'benefits' in this process has connoted the 'impacts,' including both direct benefits as well as potential losses due to uncontrolled pests, while potential health and safety problems were addressed under the 'risk assessment' part of the review process. We have maintained this approach for the Workshop.

The three groups were charged with several general tasks. First , the groups were asked to identify the critical parameters responsible for yield variability and to explain which of those parameters would be expected to have a geographic component. This latter aspect was requested as a justification for regional specificity in assessments and/or protocols. The groups were also asked to discuss what protocols could be quickly and uniformly agreed without regard to pest 'types' (weeds, insects, diseases).

The groups were also asked to discuss how quantifiable impacts (primarily yield at this point) can be compartmentalized and identified to make the benefits assessment process more transparent (that is, contain justification and accountability within the process). A synopsis of each group's report and the resulting discussion is presented below.

Plant Pathogens

The key variables required include paired-comparisons of treatments, control alternatives, disease incidence or severity and time-course with geographic and year replication, varieties used (including tolerance and/or resistance level), agronomic/horticultural information on varieties, and yield and quality or marketability (if appropriate).

Information and analyses are needed on a regional basis because of differences in climate, pathogen species and races of the same species, varietal preferences by the local markets/growers, and divergent cultural perspectives.

There was a discussion of the need for, and expenses of, standardization of experiments, with examples of national programs in tomato and alfalfa diseases. Only the very highest priority diseases could be examined and this would have to be an on-going program so that new chemicals and techniques could be evaluated. It was pointed out that even with such standardized experimental protocols, the tomato benefits assessment team still had to interpret much of the data.

A discussion of standardization noted that both the *Fungicide and Nematicide Trials* and the *Arthropod Management* journals require relatively standard formats, but not experimental protocols. If standardization is not possible, conversion factors may be plausible. The group agreed that if standardization is not possible (or desirable?), then the issue of protocols for quality assurance is critical.

Insect Pests

The critical data include yield as the bottom line, in addition to pest numbers and regional incidence. The insect group agreed with the plant pathologists on the rationale for regional assessments. The group felt that there were two major sources of the needed experimental data. *Arthropod Management (* formerly *Insecticide and Acaricide Trials)* is the major U.S. journal and easy to obtain. The second source is the myriad of unpublished (or limited publication) reports by State Experiment Stations, State Cooperative Extension Services publications and Industry Cooperative Agreement reports. In addition, there are the "file drawer" databases, containing many years of hard experimental data which have not been published. Generally, this last category may not be available except in extreme circumstances (e.g., EPA threatens a cancellation of a "key" pesticide). A database shell available country-wide would enhance the chances of obtaining this data through the state PIAP programs. The diversity and variable quality of these data mandate that any protocols developed consider some measure of quality. For experimental data, the following schema is proposed (Table 1):

Table1. The **Borth Index**. This proposed schema for describing the general quality of experimental data was suggested by Dr. Paul Borth of Dow AgroSciences. For simplicity and clarity we will refer to this approach as the "Borth Index".

Reliability Continuum	Index Description	*In situ* Replication	Geographical Replication	Seasonal (years) Replication	Quality/ Value Continuum
HIGH	**Category I**				**HIGH**
▲	Repeatable	x	x	x	▲
	Category II	x	x	--	
	May Be	x	--	x	
	Repeatable	--	x	x	
	Category III	--	x	--	
	Circumstantial (i.e., demonstrations)	--	--	x	
▼	**Category IV**	--	--	--	▼
LOW	Not Replicated				**LOW**

Our use of the Borth Index references the general concept as outlined and not specific details, which would need to be developed as different protocols for different types of data (e.g., experimental data, surveys, questionnaires, etc). With the need to both plan for the future as well as deal with emergency requirements, workshop participants agreed with the justification for including all available data. This increases the need for a quality measure based on generally accepted scientific principles. The Borth Index approach should also apply to datasets as well as individual experiments.

Weeds

The group reached a number of tenets regarding herbicide benefits assessments. Foremost is the belief that because much herbicide ends up in water systems, FQPA will have a major impact. Efficacy trials require a long list of variables including those already mentioned, plus a long list of soil measures. To obtain the needed yield and quality effects requires many studies over a wide set of conditions. Because of potential yield-enhancing effects, such trials need to be taken to final yield.

The impacts of weeds are particularly difficult to ascertain due to multi-species complexes, and the carry-over and yield-enhancing effects of some herbicides. Many of the older datasets (10+ years?) do not have standards, but there are two major standardized databases – PDMP and Field Pro. These databases and the farmer survey databases used by EPA may be reasonable for major crops, but don't contain the information needed for minor use benefits.

Yield parameters needed include weighted average of mean yields for 5 years, using blocks of field tests. Evaluate those results which are out of the average range with an explanation of the reason for not using a particular data point. Use relative yield rather than actual yield.

One of the difficulties in old efficacy data is that most of the trials do not go to yield. Therefore, yield is not known. Can we utilize old data? There were many concerns expressed that the information from old studies is not complete. We may need to set up new trials so all the data points necessary in a model would be collected. There seems to be a difference in the number of data points necessary to reach an average in minor crops and major crops. Minor crops may need significantly fewer than major crops.

Some of the data needed are: mean yield of a field trial, weeds present, weed density, and any environmental conditions which may have had an effect. This is important when plugging data into a model. A major problem is that the majority of weed scientists know how effective a chemical is but do not really know what the weed pressure is.

With the continuing fast changes occurring in the control tools available, it was felt that a lot of the older data available may be outdated. We need to include not just chemical control but also non-chemical in new field trials. New data is where the weight of the evidence should be considered.

Variables that need to be included in a protocol are: soil textures, pH values, moisture, temperature, daily rainfall ($\pm$ 2 weeks of planting), tillage method, weed densities, planting rates, planting dates, economic thresholds, and yield and quality: (scouting, comparative chemical controls, grading and quality standards).

Discussion II Synopsis

The same groups set up for the first workshop discussions were also convened for this second set of discussions. The groups were asked to consider a hypothetical benefits analysis. For the insect group, this was a specific problem on crucifers; the plant pathology group was given grapes; and the weed group was asked to conduct a benefits analysis on soybeans. The selection of crops was used to provide a breadth of crop types. Crucifers represent a limited-use crop with major resistance problems. Grapes are a perennial crop with a wide geographic distribution and a diversity of end products (juice, wine, table grapes, and raisins). Soybean, with new genetically engineered varieties, is a major field crop with wide distribution and both single and double-cropped plantings.

Each group was asked to determine what information was critical, what data useful, what information was lacking, and what protocols could be established to ensure scientifically justified assessments. Groups were also asked to prioritize their suggested protocols and estimate how meaningful and achievable the resulting data should be for regulatory purposes.

Plant Pathogens

The group discussed two time lines, one where assessments are required in the short term, using present information, and the other where time to obtain experimental data is available. The group noted that we should be looking at *impact* assessments, and not assume *benefits*, per se. The group also felt that there were not significant differences when dealing with annual versus perennial crops.; i.e., the sources and kinds of information needed remain the same with respect to protocols.

The group identified their assessment as involving fungicides on grapes. They identified a number of data sources including Fungicide and Nematicide Tests, refereed journals (i.e., Plant Disease, Phytopathology), experts (consultants, extension specialists, experiment station researchers), registrants, grower association, processors, and NASS.

The following categories of information were deemed critical: profile of control alternatives (chemical and non-chemical), status of control alternatives (what is used, rates, costs), comparative efficacy information, and yield to quality information. There was a concensus that a system should be developed to determine the credibility or quality of information/data. At the same time, the group saw a definite lack of adequate information on yield and quality.

Protocols can and should be developed which deal with the following focus areas:

1. credibility of data
2. field studies
3. standard procedures for collection of use information, etc., from growers/advisors/consultants
4. process for "quick" peer review
5. statistical analyses of data

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[illegible]

Phosphorus

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[illegible]

However, [illegible] of information were [illegible]

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Insects

The insect group used the situation of methomyl being cancelled for use on cabbage, with loopers as the target pest. The group identified a number of variables as essential for analysis (A), and important, but not critical to the analysis(B).

The following tasks were seen as required for their benefits assessment:

Identify alternatives (A). Determine the current market share of each pesticide or alternative being applied for this pest (A). Identify any imitations of alternatives (e.g., not registered in all states) (A). Assign current market share of methomyl to alternatives in proportion to their current market share (A). Identify unregistered alternatives that could be effective alternatives by next season (A) Conduct additional evaluation of unregistered alternatives (B)

Evaluation of comparative performance (A). Use these data (if available) in order of priority:

1.valid experiments taken to yield and/or quality endpoint, using data from last six years (try to find 20 tests per growing region)

2. valid experiments with efficacy data only combined with injury-loss model to estimate yield impacts. If time allows, conduct tests to validate observations from (1) and (2) (B)

3. yield loss estimates based on expert opinion. Consult published state recommendations for states that use methomyl to control loopers on cabbage (B)

Consult cabbage experts in states that use methomyl to control loopers on cabbage (Their input is especially valuable for: viability/limitations of alternatives, other alternatives (e.g., biocontrol), and other combinations of alternatives (e.g., tank mix, 2 alternatives applied during season)

Consider resistance management (A). In this situation, one alternative (pyrethroids) has well-known resistance problems. Conduct an in-depth analysis of resistance (B)

Consider the IPM value of target pesticide (A). Conduct an in-depth analysis of IPM considerations (B)

Submit report to external peer review (A). Reviewers should include cabbage experts in affected states, affected registrants, food processors, and commodity groups. Revise report based on peer review comments (A)

For every parameter it is important to assign some defined confidence value that indicates the reliability of the underlying data. The urgency of the situation will determine the amount of time allowed for analysis. In general, well-defined human risks are most urgent, followed by undefined human risks and ecological risks.

The insect group recommends three tools to assist benefits analysis:

1. Database of experts by commodity and pest. The analyst could readily identify contacts/possible data sources.
2. Database of technical resources (where data can be found).
3. Shell to evaluate comparative performance (fill in the blanks).

Weeds

The weed group focussed on wheat rather than soybeans. Their benefits analysis was basically designed from the experience of the group, primarily that of Leonard Gianessi.

Specific information that is considered critical or useful is indicated later. All information that is considered critical must be obtained for a successful assessment to be conducted. Information deemed useful should be collected to whatever degree possible. Assumed time for completing the assessment was 90 days.

For the major crops, crop statistics and usage data are generally available and sufficient. For specialty crops, much more of the data will need to be gathered. Where data for a few important states is not available, efforts should be made to contact specialists in the state to obtain needed information. Where the data cannot be obtained within a reasonable amount of time, the information should be interpolated from nearby states.

Where expert opinion is utilized, sources substantiating that opinion should be documented. What is not always available is expert opinion on infestations, recommendations, and efficacy of treatments (level of control). There is a need for databases of recommendations and infestation control levels.

Review of model results is considered essential to account for factors outside of the models parameters (i.e., wild garlic quality loss, weed resistance and crop marketability). A review of results is needed by state experts, registrants, and commodity groups.

The example used was an evaluation of phenoxys and sulfonylureas . A list of needed data and analyses is provided in Table 2 on the next page.

Table 2. List of critical information and processes for benefits assessments.

Critical →	Crop Statistics from NASS
Critical	area planted/harvested
Useful →	breakout by:
Useful	state
Useful	crop type - spring/winter/Durham
Useful	irrigated/dryland
Critical →	Usage Data - interpolated to non-responding states
Critical	NASS and Cal EPA
Useful	state specialists
Useful	growers, consultants
Useful	NCFAP and EPA, industry
Critical →	Percent acres treated by A.I.
Useful	Amount/formulation/timing/method
Useful	Trends over 5-7 years
Critical →	Prices - from state reports
Critical →	Expert opinion on:
Critical	acres infested by each pest above threshold
Critical	level of control of pest by pesticide
Critical →	Run through NCFAP model
Useful →	Run economic study of marginal value of return
Critical →	Review of results

Discussion of Recommendations

Based on the three groups and two discussion periods, there were four major focus areas selected as a point of departure for recommendations regarding protocols. Any protocols must address data (sources, types, priorities of use), quality assurance (for data and models/analysis), analysis/output (information provided, structure), and peer review (who, process, time, feedback).

Several general issues were raised concerning the overall assessment process. Is there a need for protocols regarding the establishment of the assessment team? Should specific disciplines (i.e., economics or rural sociology) always be included? What are the impacts of time constraints (rapid turn-a-rounds)? Given the time constraints often imposed, an inventory of researchers and extension personnel organized or searchable by commodity and pest would be highly valuable. The ability to search this database by state and pesticide expertise would also be important. Some of this information is already available from specific organizations such as IR-4 and disciplinary societies.

Data/Information Protocols. The initial discussion above led directly into information needs. Protocols should address the sources and types of information required for assessments. In addition to a specialist directory/database, information on pests, the damage they do, and control alternatives is obviously mandated. What are the sources of data and can we prioritize these data?

Sources of data include experimental data, some published, but much of which can be found only in the 'gray' literature (reports to experiment stations, grower associations, companies) and in paper form in storage by individual scientists. Given our disciplinary approach, even published data are spread among a diverse journal base including regional, commodity and discipline-based minor publication sources. Decisions will need to be made regarding the use of electronic information (web pages, electronic journals, web-based databases).

Regardless of source, protocols must address the issues of what information is available, identification of the source, and estimation of the quality. Priorities can be established for the weighting of information based on quality. For example, reviewed publications should carry more weight than survey results or scientific estimates. Even within comparisons of experimental data, experiments replicated across regions and years should be weighed more heavily than single experiments (see quality discussion below).

Data Protocols should address the minimum types of information required. In general, *pest data* must include pest incidence/distribution, resistance problems, yield impacts from given levels of pests, pest interspecies competition (for weeds), and biotypes or strains. *Crop data* requires acreage, yields, variety information, quality measurements (where appropriate), soil characteristics, and market prices. *Pesticide data* must include efficacy, market share, alternatives, label information, formulations, application alternatives, and other pertinent use information. All of these data, in so far as possible, should be partitioned by state (or at least region) and commodity.

[illegible] three groups and [illegible] [illegible] [illegible] depending [illegible] additions [illegible] [illegible] [illegible] information provider [illegible]

Several [illegible] Issue Areas [illegible] the overall [illegible] [illegible] [illegible] [illegible] [illegible] technology) always [illegible] [illegible] [illegible] [illegible]

Individual [illegible] [illegible] [illegible] [illegible] [illegible] sources [illegible] [illegible] sources [illegible] [illegible]

Sources [illegible] [illegible] [illegible] published, but [illegible] can be found [illegible] [illegible] [illegible] [illegible] information [illegible] [illegible] [illegible]

[illegible] sources [illegible] [illegible] [illegible] quality [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] single experiment [illegible]

[illegible] types of information [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] quality [illegible] [illegible] All of [illegible]

Quality Protocols. Quality assurance has been a major issue in benefits assessments for regulatory decisions. For experimental data and databases, protocols should use some index which takes into account the amount and type of replication. The participants agreed that some form of what we termed the Borth Index (see summary of Discussion Session I) would provide an adequate quality measure for "hard" data. A similar approach could be used for questionnaires and surveys (by estimating the breadth and depth of questions and responders), and, perhaps, even scientific estimates (by assessing the experience and disciplinary diversity of the scientists). Criteria should be established for statistical analyses and models used in assessments based on the types of assumptions and the level of documentation. These protocols would be subject to public review and comment (and change with new methodologies and technologies).

Analysis/Output Structure Protocols. With EPA as the primary client/customer, protocols, which specify the nature and form of analysis or model output, are crucial. By providing the types of information EPA needs (in a structured form which doesn't require extrapolation or modification), considerable time and potential for error could be avoided. Standardization at this level is easier to achieve than for field experiments themselves. Such protocols also can be developed to help make the results easier for the non-scientist or non-specialist to understand.

It is important that the end user groups define the format and information content. This may involve protocols which specify structures/content dependent on the end user. EPA and commodity organizations may need somewhat different analyses and/or results structure. Those developing the specific protocols should be sensitive to these differing needs.

Review Protocols. These protocols should cover who is to be involved in the review process, what role each reviewer plays, how it is carried out, and how differences in reviews are to be handled. The workshop participants felt that all impacted parties should play a part in the review. EPA can play a critical role in the review process by providing feedback prior to the assessment submission. By fully involving EPA, the resulting assessment will be certain to answer specific questions EPA personnel may have regarding the given assessment and supporting data/documents.

Workshop participants recommended that there be specific protocols to deal with responses to reviews and methodologies for conflict resolution. Methods need to be defined by which the assessment team is responsive to reviews. Suggestions and criticisms should not be ignored or automatically included. Where strong differences in interpretation exist, there need to be guidelines that provide for evaluation of these differing interpretations.

Final Comments. Workshop participants felt that it is important to proceed with the establishment of specific protocols. USDA, working with EPA, should establish an *ad hoc* group for this purpose. There was general concurrence on the focus areas for protocols and the information/processes for which protocols are needed. Proceedings for this workshop were submitted to all participants for review and comment.

Speakers/Demonstration Topics

A Historical Perspective on Crop Loss Estimation
Charles Main, Plant Pathology

This was a review of a program in North Carolina in the 1970's and 1980's which provided crop loss estimates for all crops in North Carolina. The program used surveys and scouting for the information source and was discontinued when funding was cut.

Weed Management and HDDS (Herbicide Decision Support System)
Gail Wilkerson, Systems Science

HDDS is a Windows-based decision support system. The output can provide per acre estimates of yield loss due to specific weed species and the economic benefits from the use of specific herbicides.

The NCFAP Assessment Model
Leonard Gianessi, Economics and Policy

The NCFAP approach uses available information on pests, crops and pesticides for benefits analyses. The processes of data selection, incorporation, and analysis were explained. Data sources were described.

A Pesticide Benefits Assessment for Cotton
Robert Nichols, Policy

A recent assessment process for cotton pesticides was briefly described with emphasis on the types and sources of data used. Areas of missing information were also described.

Weeds and Herbicide Benefits Assessments
David Pike, Weed Science

The variables necessary for benefits assessments for weed management were described, as well as a number of weed and herbicide-specific problems encountered in assessments.

A Web-based Damage/Yield Loss Model/Data Inventory
Ronald Stinner, Entomology

A new web-based database effort was described. The database consists of abstracts from published literature detailing the impact of specific pest population levels or indices on yield.

Printed Information Provided to Participants

Hutchins, Scott H.1995. Pest Control Technology Benefits Methodology Working Group – A Concept Paper. Unpublished

Osteen, Craig, and Rob Esworthy. 1997. NAPIAP: Issues in estimating benefits of pesticides. Proc. Third National IPM Symp./Workshop. Feb 27 – March 1, 1996. Pp 134-135.

Stinner, R. E. 1995. Development of model systems for benefits assessments of management tactics in integrated pest management. A Proposal to NAPIAP, ACPA, and EPA. From the Center for Integrated Pest Management. Unpublished.

Stinner, R. E. 1997. Estimating biological benefits of pesticides for regulatory decision making. Proc. Third National IPM Symp./Workshop. Feb 27 – March 1, 1996. Pp 132-133.

Pest Control Technology Benefits Methodology Working Group

A Concept Paper

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Introduction:

The utility of Integrated Pest Management (IPM), including the value of pest control technology specifically, has not been adequately quantified -- at least to the extent that research and regulatory decisions require. Indeed, although the value of a specific technology or combination of technologies within a pest management scenario may be empirically assumed, a clear and consistent method for assessing benefits (vs. features) has not been developed and implemented. This has resulted in:

- An inability to quantitatively and objectively assess risk AND benefits within a single equation, leading to the possibility of inappropriate regulatory action
- Inadequate or unrealistic expectations regarding the acquisition and usefulness of product performance data to assess the "value" of technology
- A fragmented approach to evaluation of IPM systems leading to poor research focus and unrealistic expectations as to overall versus situational value of IPM
- Product and technology goals focused on perceived benefits rather than actual benefits

A clearly defined methodology, including protocols for specific types of assessments must be developed, validated, and adopted in order to ensure USDA, EPA, and registrants of technology are working toward the same objectives.

Purpose and Scope:

To address the pervasive need for assessing the benefits of pest control technology, the establishment of a *Pest Control Technology Benefits Methodology*

Working Group is proposed. The proposed membership/sponsorship within a core team would include USDA (specifically the National Agricultural Pesticide Impact Assessment Program [NAPIAP]), EPA (specifically the Biological and Economic Assessment Division [BEAD]), and the American Crop Protection Association (ACPA). In addition to these stakeholders and core planning groups, any number of third party research institutions or centers (e.g., Center for Integrated Pest Management) would play a critical role with developing the protocols required for comprehensive benefits method development.

The scope of the proposed working group would include:

- Identification and consensus of categorical benefits (e.g., human safety) that require valuation with developed methodology (a theoretical list of possible benefits that might require consideration is attached).
- A technique or protocol for assessing value to a specified beneficiary. These methods should transcend obvious techniques and include novel biological and economic modeling approaches to assess both tangible and intangible benefits.
- Integration of all the categorical benefits within an overall model to determine collective or net value. The output or product of the benefit assessment should "link" with the output or product of the risk assessment.
- Techniques to incorporate probability and simulation modeling techniques as a means to incorporate uncertainty and develop sensitivity analysis will be critical for the decision-making and policy-setting utility of the risk:benefit models.

Work Group Process:

Once commissioned as a dedicated initiative for the sponsoring groups, a series of meetings to outline and manage the project would be necessary. The core team would consist of three key members from each organization with the charge to:

- Systematically dissect the numerous issues associated with benefits assessment from all perspectives, especially those affected by methodology shortfalls.
- Partition the issues into categorical benefits with associated beneficiaries. Develop or commission a subteam of experts to review the specific issues associated with each benefit/beneficiary combination; subteams have accountability for

recommendations regarding protocol development and use. A final set of protocols and methodology must be agreed to by USDA, EPA, and ACPA for uniform and consistent implementation.

- Establish of product or technology characterization guidelines that will integrate within the benefits methodology and provide utility to both registrants and regulatory agencies.
- Develop expectations and requirements for continuous improvement of the methodology as new techniques evolve. Develop review and appeal guidelines to cover situations or circumstances where a product or technology does not "fit" within the established methodology.

Summary:

Pest control technology provides dramatic benefits to end users and society as a whole, but these benefits generally are poorly understood and rarely quantified. In order to adequately assess the net utility of any product or technology to all parties, however, some estimate of both risk and benefit is required. To address this ongoing need, a *Pest Control Technology Benefits Methodology Working Group* is proposed with core membership from USDA, EPA, and ACPA. The purpose is to develop a set of consistent and accurate protocols to assess benefits of technology as part of the regulatory and product advancement decision process, but also to demonstrate the value of environmental stewardship and IPM in ways heretofore not quantified.

WHAT ARE THE BENEFITS OF PEST CONTROL AND/OR BENEFICIAL ASPECTS OF PEST CONTROL TECHNOLOGY?

HUMAN SAFETY

NON-DIETARY RISK

- Good (improved) toxicological profile
- Safe to:(5) easy to apply or use Toxicity
- Safe to use/handle
- Safety
- Caution vs danger label

DIETARY RISK

- Safe to:
  - -workers
  - -consumers
  - -non-target species
  - -env. contamination
- Safer pesticide
- Safety to humans & worker exposure
- Reduce residues

ENVIRONMENTAL SAFETY

NON-TARGET SPECIES

- Safety to environment
- Environmental impact(ECL)
- Good(improved) env. profile
- Non-toxic mfg. waste
- Mfg. waste utilization (Telone)
- Reduced mfg. waste

CONSERVATION& PRESERVATION

- "Natural Product"
- Overall Benefit to the env.
- Reduced use-volume
- Ability to remediate contaminated sites
- Better for the env. (N stabilizer)
- Compatible with all tillage sys.
- Eliminates more risky products

CONTAINING DISPOSAL

- No container disposal issues

HUMAN HEALTH

- Safe commodities for consumption (public health)-ergot in wheat
- Reduce diseases like plague, yellow fever, etc..
- Reduce discomfort due to insect bites
- Improve safety of intersections on streets & highways
- Higher quality end product
- Quality of food & fiber
- Eliminates dangerous pests
- Minimizes disease

QUALITY OF LIFE

- Prevent embarrassment for homemakers
- Provide professional image for corp. offices, retail estab., public parks, sports stadiums, to encourage patronage
- Improve beauty of lawn & gardens at home
- Reduce discomfort due to fear of/dislike for insects
- More eye appeal-field looks better
- Provide a nice view for people to look at
- Reduces nuisance of unwanted species
- Provide a good surface for putting/hitting other golf shots
- Quality of life improvement

DIRECT FINANCIAL RETURNS

OUTPUT ECONOMICS

- Higher yield
- Yield
- Yield: food, fiber
- Good efficacy improves crop yields, quality

OUTPUT VARIABILITY

- Ability to reduce yield variability
- Peace of mind(insurance input)
- Rotational crop safety

OUTPUT QUALITY

- Crop quality
- Moisture content
- Higher protein

INPUT ECONOMICS

- Save money vs manual or mech. weed control
- Low cost to produce to cust.
- Reduce damage to power lines
- Reduce damage to RR & hwy. rights-of-way due to veg. encroachment
- Reduce crop/structure damage due to pests
- Reduce weed/free competition for tree seedlings(conifer rel.)
- Higher home value(lawn care)
- Competitive advantage
- Profit to producer

RESOURCE SUBSTITUTION (EFFICIENCY)

- Reduces work to raise crops
- Save time, fuel, equip. invest., etc. with conservation tillage
- Time saving
- Save time for home gardener, landscape maint., Co.'s & home-owner's (lawns)
- Cost of production
- Cost/value
- Less manual labor needed (hoeing,etc.)
- Improved utilization of resources
- Efficiency: time
- Less stress on producer(in. policy)

INDIRECT FINANCIAL RETURNS

- Dealer margins of profit
- High tech jobs
- Jobs for chem. industry employees
- Jobs/employment
- More income for producer
- Profit for maker/producer/mfg.
- Taxes on profits to the government
- More competitive agr.(cheaper food, more trade)
- Reduces food costs
- Ensures adequate supply of food
- Cost of goods
- Technology overlap into other spec.
- Enhances employment of people

CUSTOMER DISCRIMINATING ATTRIBUTES

CONVENIENCE OF USE

- Non-restricted use designation
- No odor
- WPS compliance
- Minimal application restrictions
- Reduced # of appl/increased time between appl.
- Packaging delivery system
- Low use rate
- Minimal training required for use
- Improve access to pipelines & powerlines
- Labeled for multiple crops

TARGET SPECTRUM

- Broad spectrum
- Broad spectrum control
- Multiple categories of activity (insects/diseases)
- Efficiency: 2+ for 1 pest control

EFFICACY

- Level of control
- Rate/dose

IPM COMPATIBILITY

- Prescriptive in use
- Fits in IPM systems

MODE OF ACTION

- New biotechnology
- New chemistry
- Improved standards
- New technology
- Resistance management of pesticides current & future
- New mode of action

NAPIAP: Issues in Estimating Benefits of Pesticides

Craig Osteen
National Agricultural Pesticide Impact Assessment Program, USDA
Rob Esworthy
U.S. Environmental Protection Agency
Moderators

This session focused on issues of estimating economic impacts of pesticide regulations. These issues are important to IPM because pesticides are important tools in many IPM programs. Pesticide regulations can reduce the options available for some IPM programs with undesirable pest control, environmental, and resistance-management consequences. These concepts can also be applied to analyzing the economic impacts of IPM adoption.

EPA and USDA/NAPIAP have created a working group to review currently used economic methods of USDA and EPA pesticide benefit assessments because of questions raised about their quality. The ultimate purpose is to develop an improved set of guidelines for estimating the economic effects of pesticide regulatory actions. The primary questions of concern are:

1. Are we trying to measure the right things?
2. What methods to estimate economic effects are feasible, given restrictions on time, manpower, etc.?
3. Assuming that acceptable methods are being applied by USDA and EPA, are they being properly applied?
4. Are there new methods that should be employed?

Economic Analysis in the Pesticide Regulatory Process

Rob Esworthy discussed the role of economic analyses in risk-benefit comparisons under FIFRA Special Reviews and other registration decisions and in regulatory-impact analyses. In EPA, as well as NAPIAP, biologists and economists cooperate in the benefit-assessment process. The key elements in assessing the benefits of a pesticide used on a crop include: major pests controlled, chemical and/or nonchemical alternatives to the pesticide, and comparative performance of the alternatives in terms of pest control and crop yield or quality. Ultimately, the economic analyses require estimates of the use of the pesticide in question and changes in yield, quality, and/or production cost associated with changing to alternative control measures.

The Current Approach

Conceptually, the assessment of benefits by USDA and EPA is the same as estimating the annual net efficiency loss of removing the pesticide from the market and switching to the best alternative control option. Monetary values generally are not estimated for health and environmental effects of proposed regulatory actions, which are considered in EPA risk assessments. However, the economic-impact estimates can be used to estimate cost-effectiveness of risk-reducing options.

The standard framework for estimating the net economic effect is based on traditional Marshallian demand-and-supply curves. The supply curve is modified to reflect changes in yield and cost; price and quantity changes are estimated; and changes in consumer and producer surpluses are summed to estimate net effect.

Partial budgeting (change in value of production plus cost change) is used to estimate net effect when price changes are expected to be negligible or data to estimate price changes are not available. A variation on partial budgeting is often used when yield or quality losses are difficult to value: pest control experts are asked to develop equally effective control options, and the net effect is estimated as the cost of the new option minus the cost of the current approach.

Pesticide regulations can affect various groups differently. These so-called distributional effects are not obvious from the "net effect."

Distributional effects estimated in assessments often include economic effects on purchasers of affected commodities, growers of affected commodities, users and nonusers of the regulated pesticide, regions where economic losses are particularly severe, and growers of other crops. Changes in commodity-program payments are also estimated, where appropriate, because they can shift the distribution of impacts.

Several methods are used to address price effects and associated welfare effects: demand-and-supply elasticities in simple static-equilibrium models; mathematical (quadratic) programming models; and econometric simulation models, such as AGSIM, that account for simultaneous price, acreage, consumer, and producer effects for several crops.

Comments by Panel

Fred Kuchler argued that the economic effects of pesticide regulations would ultimately affect rents and values of land, a primary fixed factor of production. This link may be an important distributional effect because approximately 40 percent of land in U.S. farms is rented. At one time, most farmers owned all the land they farmed, so separating this effect was not important. But a significant portion of farmland is now owned by people who do not farm. Share rents would be affected in the same years as effects of pesticide regulations on costs and yields occur. Potential renters would ultimately change their cash rent bids as changes in prices, yields, and costs became apparent.

Jerry Carlson focused on some important costs typically neglected in the benefit assessment process: phytotoxic effects of replacement pesticides, changes in drift damage to adjacent fields, changes in resistance development for remaining pesticides, and changes in the variability or risk of crop yield. In addition, there can be effects on the value of human capital: regulations could force growers to use new, unfamiliar techniques and receive lower financial returns until they gain experience with them. Carlson felt that there were difficult tasks where improvement was needed: (1) correctly estimating market shares of replacement controls and (2) estimating crop yield changes for different technologies in different regions by using experimental data. Two other important issues that need to be addressed are estimating changes in commodity-program payments and changes in unit prices of remaining pesticide products.

Erik Lichtenberg argued for a different approach to estimating the effects of regulations and focused on issues of data and data quality. He argued that crop science data fit poorly into the traditional economic framework, and better results could be obtained by collecting data capable of supporting estimation of economic relationships directly. Such data could be collected through USDA Farm Costs and Returns Surveys or pesticide-use surveys. The data currently collected are not sufficient by themselves, however, and would need to be augmented to include such items as: (1) output (yield) information; (2) quantities of individual pesticides used; (3) quantities of other inputs used, such as fertilizers, labor, cultivation methods, other nonchemical control methods, etc.; and (4) prices of all of the above. Panel data that included both cross-sectional and time-series information would support the use of dual methods and estimation of supply and input demand curves. Cross-section data alone would support estimation of production functions directly. The damage-control approach of Lichtenberg and Zilberman could be used to estimate damage; such estimates would be useful to cross-check damage estimates of crop scientists.

Erik Lichtenberg identified some other issues. First, assumptions of perfect competition (no individual buyer or seller can affect market price) may be invalid in some markets. Large buyers of agricultural commodities, such as grain marketers or food processors, could influence the prices that growers receive. In addition, national governments play an important role in marketing commodities in international markets. Second, it is not clear how effects on first-level purchasers of agricultural commodities transmit to effects on retail-level consumers, so that the "consumer effects" currently identified may relate to wholesalers but not retail-level consumers.

Estimating Biological Benefits of Pesticides for Regulatory Decision Making

Ron Stinner
North Carolina State University
Moderator

Introduction

The National Agricultural Pesticide Impact Assessment Program (NAPIAP), a USDA/State program, was established in 1976 to promote informed regulatory decisions on agricultural pesticides. NAPIAP develops and distributes science-based information evaluating the benefits of pesticides in U.S. agricultural production. The information in NAPIAP assessment documents is provided to the U.S. Environmental Protection Agency (EPA) for use in its regulatory decision-making process. These documents also provide useful information to the USDA, agricultural scientists, and commodity groups. In February 1995, a panel reviewing NAPIAP criticized the program for using excessive "expert opinion" (scientific estimates) in lieu of documented biological data in these assessments. At the same time, the benefit-assessment process has suffered from a lack of protocols that could be used to guide the acquisition of such data. In an effort to better refine the benefit-assessment process, a Benefits Assessment Protocols Working Group was formed in 1995 to address these issues. The Working Group consists of representatives from USDA, EPA, and the American Crop Protection Association (ACPA). This workshop is the first result of the ongoing discussions on the development of assessment protocols.

The panel participants have all had experience with NAPIAP and the benefit-assessment process. Drs. Jenkins and Pike are the NAPIAP State liaison representatives for their respective States and have also participated in the assessment process. Dr. Bridges was a member of the panel that reviewed NAPIAP; he also has done an assessment, using an innovative approach, of the benefits of pesticide use in peanut production.

Panel Presentation

Dr. Jenkins discussed the Pesticide Benefits Assessment Model, developed at Ohio State University. This model attempts to assess the true economic impact of alternative control strategies and to provide information useful to regulatory decision making. The advantages of such an approach are: improved credibility and reliability, less expert opinion, consistent framework, and the development and use of formalized models. He also discussed the data needs and sources presently available.

Dr. Bridges pointed to the major problems with the present benefit-assessment process: imbalance in risk and benefits (with large sums spent on risks and little on benefits), credibility (risk well-defined with systematic approach to assessment; benefits more diffuse and difficult to define), little investment in benefits methodology, and an underestimation of the importance of biological components and their variability. This is true for agribusiness as well as government regulators and university cooperators. Dr. Bridges recommended that NAPIAP develop a common ground for assessments that includes: (1) multiuser databases of pest occurrence (and damage) and demographics of pest-management practices and (2) common, consensual, and systematic processes for assessments.

Dr. Pike addressed the history of assessments, noting that there has always been a balance of both expert opinion and empirical evidence, with the pendulum now moving away from expert opinion. He noted that in spite of regional variations and requirements, NAPIAP should be able to develop a set of protocols that include subjectivity; that is, both models and individuals to interpret the information (model, expert opinion, and empirical data).

Discussion and Conclusions

Numerous questions were raised, such as: How do you estimate the costs of practices (e.g., resistance management, new-product costs, and value of product alternatives)? This question led to a

discussion of individual costs versus averaging and the value of prior knowledge (e.g., we know that curative methods always produce a higher return than prophylactic treatments when we average, but not necessarily when looking at individual years and fields).

Where are the data? Can we realistically estimate yield as related to damage indices? Are such models well known, and more important, are they transparent (is it obvious what they do)? This discussion led to a major conclusion that the concept of transparency was critical to the benefit-assessment process. A main concern with expert opinion is how interpretations are made from point A (data or estimates) to point B (recommendations). If the entire logical process from A to B is made clear (hence the term, transparent), then it stops being expert opinion and becomes empirical information. Because yield-quality effects are the most difficult to estimate, models become necessary tools. However, the inherent complexity and variability of our agricultural system demand that any model results be interpreted and analyzed in light of this variability.

The workshop concluded with the consensus that NAPIAP should develop protocol criteria that include the use of transparent models and careful analysis while not forgoing expert opinion. All affected parties should be a part of the development of these protocols. Benefit assessment should be an integral part of product development.

Development of Model Systems for Benefits Assessments of Management Tactics in Integrated Pest Management

A Proposal to

USDA/NAPIAP
ACPA
EPA

from the Center for Integrated Pest Management

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INTRODUCTION

Current regulations require that benefits and risks of products be assessed when pesticides are evaluated for continued registration or reregistration. Risk assessment protocols are well documented, with both regulators and industry understanding what must be accomplished to provide a risk assessment. The "benefits" side of the equation, however, is much more complex and the end result of a "benefits assessment" much more probabilistic, and subject to criticism. This proposal seeks to define an approach to the development of benefits assessment methods protocols. It does not address the issue of defining the specific protocols, but rather the process to be used and some of the information required.

EPA, NAPIAP, and ACPA all have a vital stake in benefits assessment. The National Agricultural Pesticide Impact Assessment Program (NAPIAP), a U.S. Department of Agriculture (USDA)/State program, was established in 1976 to promote informed regulatory decisions on agricultural pesticides. NAPIAP develops and distributes science-based information evaluating the benefits of pesticides in U.S. agricultural production. The information in NAPIAP assessment documents is provided to the U.S. Environmental Protection Agency (EPA) for use in their regulatory, decision-making process. Because these decisions are critical to members of ACPA, their input into this process should be encouraged.

In February 1995, a panel reviewing NAPIAP criticized the program for using excessive "expert opinion" (scientific estimates) in lieu of documented biological data in these assessments. The benefits assessment process has suffered from a lack of protocols which could be used to guide the acquisition of such data. In an effort to better refine the benefits assessment process, a Benefits Methodology Working Group was formed in 1995 to address these issues. The Working Group consists of representatives from USDA, EPA, and the American Crop Protection Association (ACPA).

Currently the assessment of benefits focuses on producers and, to a limited extent, on consumers from an economic perspective. There are other significant aspects of benefits that merit consideration, such as the availability of an abundant and varied food supply free from pests and the hazards imposed by chemicals that pest infestations induce (e.g., phytoalexins and mycotoxins). These health related benefits are complex, and a great deal of effort would be required to refine approaches to characterize and measure them.

APPROACH

This is a continuation of a project by the same title. The process of protocols development has five phases:

I. Elucidation of desired protocol goals

II. Assessment of data needs

III. Development of a models inventory (database)

IV. Collection and integration of additional databases

V. Actual protocol development.

Based on the above information, protocols could be set in place which clearly define the product-specific information needed to provide acceptable benefits assessments. Phases I and II have already been addressed by the Benefits Methodology Working Group, as outlined below under the initial year of funding for this proposal. The focus of this proposal is the collection of a Model Inventory and online searchable database.

Elucidation of Protocol Goals

A series of meetings on the Benefits Methodology Working Group has already defined the desired goals for the group members, from their perspectives, as outlined below.

ACPA:

- Need to establish clear expectations from regulatory agencies on what is required and why with regard to product benefits
- Understand how product attributes relate to product benefits
- Advance product candidates based upon an accepted risk:benefit ratio
- Meet/exceed expectations of regulatory agencies for submission of benefits data
- Improve the image of agricultural products and objectively describe the value of new technology and IPM
- Describe tangible and intangible benefits of products.

USDA:

- Establish transparent objectivity in the assessment of product or technology benefits, much like risk assessments do today

- Develop protocols and techniques to quantitatively assess product benefits without dependence on specific comparative product studies in the field

EPA:

- Develop credibility behind benefits assessments in order to allow objective tradeoff decisions with risk assessments

- Develop realistic expectations for collection and use of product performance data and link this to damage or crop loss models

- Organize and utilize existing data on product performance for current and anticipated regulatory actions.

ASSESSMENT OF DATA NEEDS

The Benefits Methodology Working Group has held several meetings to discuss data needs. In addition, NAPIAP funded (through the Center for IPM) a workshop (Estimating Biological Benefits of Pesticides for Regulatory Decision Making) at the National IPM Symposium/Workshop in February of this year. The workshop consisted of three panel speakers and a lengthy discussion. The panel included Drs. David Pike, Jeff Jenkins, and David Bridges. The panel participants all had experience with NAPIAP and the benefits assessment process. Drs. Jenkins and Pike are the NAPIAP State Liaison Representatives for their respective states, and have also participated in the assessment process. Dr. Bridges was a member of the panel that reviewed NAPIAP; he has also done an assessment, using an innovative approach, of the benefits of pesticide use in peanut production.

A proceedings will be published shortly for the Symposium/ Workshop. The discussion led to the conclusion that the concept of transparency was critical to the benefits assessment process. A main concern with expert opinion is how interpretations are made from point A (data, estimates) to point B (recommendations). If the entire logical process from A to B is made clear (hence the term, transparent), then it stops being expert opinion and becomes empirical information. Because yield/quality effects are the most difficult to estimate, models become necessary tools. However, the inherent complexity and variability of our agricultural system demands that any model results be interpreted and analyzed in light of this variability.

The workshop concluded with the consensus that NAPIAP should develop protocol criteria which include the use of transparent models and careful analysis, while not forgoing expert opinion. All affected parties should be a part of the development of these protocols. Benefits assessment should be an integral part of product development.

There was significant disagreement in both the Workshop and the Working Group as to the availability of the models required for such transparent analyses.

Development of a Model Inventory

The collection and organization of a Model Inventory is a complex task requiring consideration of all the data needs. For even simple benefits assessments, two major categories of models (or data) are required: (1) density-damage models and (2) pest occurrence information.

Density-Damage Models (Single Species). This group of models are generally simple, usually crop- and site-specific regression models. Most of these models are "single species" descriptions for insect and disease damage. Work on cataloging these models has already begun. Dr. Rosanne Minarovic, a crop scientist, is searching the NCSU library, which has an extensive agricultural journals collection. Papers containing these models are being copied and Model Inventory Data Forms (MIDFs) prepared for each model. These MIDFs contain information on the crop, pest, location, pesticides used (if pertinent), and necessary model descriptions.

The MIDFs are in a standardized format and will be stored for the present as WordPerfect files (see Model Inventory Database Development).

Density-Damage Models (Multiple Species). Because weeds generally occur in multiple-species associations, and because weed yield loss is not necessarily additive, weeds damage requires a multi-species approach not handled by standard statistical models. There are a number of other models, such as HERB (Coble et al.), which are already available for examining economic benefits of varying weed management tactics. These models are beyond the scope of this proposal. I have, however, contacted Dr. Coble and we will cooperate in any way necessary to integrate these models with our "single-species" inventory.

Pest Occurrence. Having an inventory of density-damage models is only the first half of the equation. We must also have detailed information on pest occurrence and demographics. That is, to assess total damage (and thus economic benefit from control), we must use both the damage resulting from given densities and how often these densities occur in a specific region. This information (where, frequency, levels of infestation) will have to be gleaned from NAPIAP surveys, literature reviews, and expert opinion (documented where possible).

Model Inventory Database Development

All of the information inventoried will be stored initially

as WordPerfect and text documents. In order to efficiently and effectively search (and integrate) the model inventory, the WordPerfect "Model Inventory Data Forms" will be translated into an SQL-compliant, relational database, such as Microsoft Access. We are currently installing a new Windows NT server and could easily make the database accessible to authorized individuals via the Internet using Web-based forms. The database could also be made available through CD-ROM or direct FTP. If funds are available for the "Pest Occurrence" inventory, that effort would include programming for on-line compilation of state/regional benefits, based on average pest occurrence and resulting damage. The databases will also be compatible with the new "Pest Management Information/Decision Support System" being developed by CSREES and NAPIAP with Terry Janssen at Argonne National Lab.

Collection and Integration of Additional Databases

Phase IV will only be initially investigated in this project. This will be a continuation of a project under the same title.

There are numerous complex decision aids and crop simulation models which could wholly or partially replace site-specific models, and fill state or regional data gaps. Identification and review of these models will be a time-consuming process, but could be a critical "boost" to methodology protocols. Resulting databases would need to be integrated into the model inventory database.